

Discussion Paper Series

Labor Productivity of Transportation  
Sector in Thailand: Analysis using  
Input-Output Approach

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# **Discussion Paper**

Labor Productivity of Transportation Sector in Thailand:

Analysis using Input-Output Approach

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## Abstract

Labor productivity reflects the ability of an industry or country to generate higher income. The share of transportation sector has been accounted for 7 to 9 percent of country's GDP since 1990. Due to the large share of the transportation sector to the overall economy, this sector is considered as an important service sector to facilitate the overall economic growth. This paper attempts to determine the labor productivity of the transportation sector using the input-output analysis approach. The study incorporates four modes of transport which are rail transport, road freight transport, water transport and air transport. The methodological setting is the utilization of the "labor coefficients" calculated from input-output tables of Thailand for the years 1990, 1995, 2000 and 2005. The results show that labor coefficients of overall transportation sector have not changed much during the period of study. However, labor productivity of water transport sector has improved while labor productivity of rail transport sector has become lower since 1990.

ประสิทธิภาพของแรงงานเป็นปัจจัยหนึ่งที่มีอิทธิพลต่อความสามารถในการสร้างรายได้ของประเทศ และ/หรือภาคการผลิต สำหรับประเทศไทย มูลค่าผลผลิตจากสาขาการขนส่งมีค่าประมาณร้อยละ 7 ถึง 9 ของผลผลิตมวลรวมประชาชาตินับตั้งแต่ปี พ.ศ.2533 เป็นต้นมา สาขาการขนส่งจึงนับเป็นภาคบริการที่มีบทบาทสำคัญต่อการเจริญเติบโตของระบบเศรษฐกิจไทย บทความนี้มีวัตถุประสงค์เพื่อต้องการศึกษา ประสิทธิภาพของแรงงานในสาขาการขนส่ง 4 รูปแบบ ได้แก่ การขนส่งทางรถไฟ การขนส่งทางถนน การขนส่งทางน้ำ และ การขนส่งทางอากาศ โดยในการศึกษานี้ วิเคราะห์ประสิทธิภาพของแรงงานจากค่าสัมประสิทธิ์แรงงาน (labor coefficients) ที่คำนวณโดยใช้ข้อมูลจากตารางปัจจัยการผลิตและผลผลิตของประเทศไทยในปีพ.ศ. 2533, พ.ศ. 2538, พ.ศ. 2543 และ พ.ศ. 2548 (ซึ่งเป็นข้อมูลล่าสุดที่มี ณ วันที่ทำการศึกษานี้) ผลการศึกษาพบว่า ค่าสัมประสิทธิ์แรงงานที่ใช้เป็นตัววัดประสิทธิภาพของแรงงานของสาขาการขนส่งโดยรวมไม่มีการเปลี่ยนแปลงมากนักตลอดช่วงเวลาที่ทำการศึกษา อย่างไรก็ตาม ประสิทธิภาพของแรงงานในสาขาการขนส่งทางน้ำมีการปรับเพิ่มขึ้น ขณะที่ประสิทธิภาพของแรงงานในสาขาการขนส่งทางรถไฟกลับมีค่าลดลงตั้งแต่ปี พ.ศ.2533 เป็นต้นมา

## 1. Introduction

Economic growth is fundamental to economic development. The economy of Thailand has emerged as one of the fastest growing economies in the world. The past four decades have been a period of major transformation for the Thai economy changing from agricultural to manufacturing based economy. However, the service sector has become more important during the last two decades. The main contributor to GDP of Thailand no longer originates from agriculture and manufacturing sectors but from service sector.

Table 1 shows that service sector had accounted for more than 50 percent of GDP from 1990 to 2011. Transport, storage and communications sector has been found to be the second largest subsector among others in service sector, follows wholesale and retail trade subsector since 2000 (see Table 1). In addition, the share of Transport, storage and communications subsector in GDP has been increasing from around 6 percent in 1990 to 9.1 percent in 2011.

**Table 1** Share of the gross domestic product by sectors in Thailand, 1990 - 2011 (%)

Sector	1990	1995	2000	2005	2010	2011
<b>Agriculture</b>	<b>9.8</b>	<b>8.0</b>	<b>9.3</b>	<b>8.1</b>	<b>7.3</b>	<b>7.7</b>
<b>Mining and quarrying</b>	<b>1.9</b>	<b>1.9</b>	<b>2.4</b>	<b>2.5</b>	<b>2.5</b>	<b>2.4</b>
<b>Manufacturing</b>	<b>25.2</b>	<b>26.3</b>	<b>28.4</b>	<b>29.8</b>	<b>31.1</b>	<b>29.4</b>
<b>Construction</b>	<b>6.7</b>	<b>7.3</b>	<b>3.0</b>	<b>3.0</b>	<b>2.8</b>	<b>2.6</b>
<b>Services</b>	<b>56.6</b>	<b>56.5</b>	<b>57.0</b>	<b>56.6</b>	<b>56.2</b>	<b>57.8</b>
Electricity, gas and water supply	1.5	2.3	2.9	3.0	3.2	3.2
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	19.3	18.9	16.9	15.2	15.2	15.2
Hotels and restaurants	4.6	3.5	3.9	3.4	3.6	4.0
<b>Transport, storage and communications</b>	<b>6.2</b>	<b>6.1</b>	<b>7.9</b>	<b>8.4</b>	<b>8.9</b>	<b>9.1</b>
Financial intermediation	6.7	9.6	4.3	5.1	5.0	5.2
Real estate, renting and business activities	4.8	4.3	7.0	8.2	7.7	8.0
Public administration and defense; compulsory social security	4.4	4.5	6.0	5.4	5.5	5.7
Education	4.1	3.4	4.0	3.6	3.5	3.5
Health and social work	1.3	1.2	1.5	1.6	1.7	1.8
Other community, social and personal service activities	3.0	2.4	2.3	2.3	1.7	1.8
Private households with employed persons	0.6	0.4	0.4	0.3	0.2	0.2
<b>Gross Domestic Product</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Source:** Calculated from National Accounts of Thailand. (Chain volume measures: reference year = 2002)

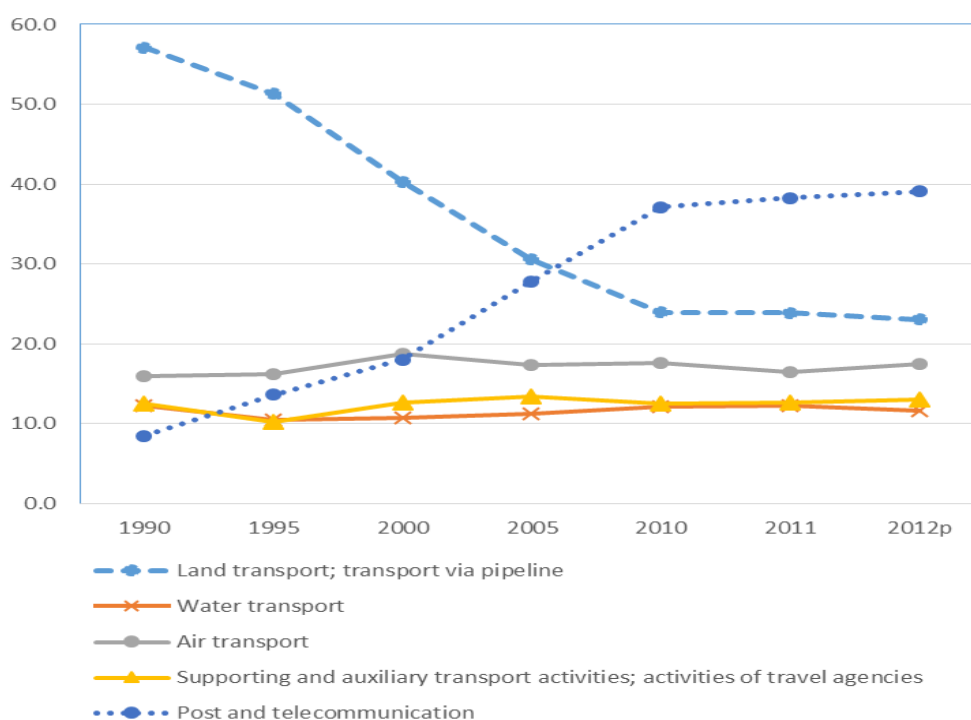
The contributions of all subsectors to the total value added of transport, storage and communications sector from 1990 to 2012 are shown in Table 2 and Figure 1. The shares of water transport, air transport, and supporting and auxiliary transport activities subsector to total value added of transport sector in 2012 were almost the same as in 1990 while the shares of land transport and post and telecommunication subsectors to total value added of transport sector have changed significantly during the same period. The share of land transport; transport via pipeline to total value added of transport sector was significantly decreased from 57.1 percent in 1990 to 23.1 percent in 2012. On the contrary, the share of post and telecommunication to total value added of transport sector was dramatically increased from 8.5 percent to 39.1 percent in the same period.

**Table 2** Share of the gross domestic product originating from transport, storage and communications in Thailand, 1990 - 2012 (%)

<b>Subsector</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2011</b>	<b>2012p</b>
Land transport; transport via pipeline	57.1	51.3	40.3	30.6	23.9	23.9	23.1
Water transport	12.2	10.5	10.7	11.2	12.1	12.3	11.6
Air transport	16.0	16.2	18.7	17.3	17.6	16.5	17.5
Supporting and auxiliary transport activities; activities of travel agencies	12.5	10.3	12.7	13.4	12.5	12.6	13.0
Post and telecommunication	8.5	13.6	18.0	27.8	37.1	38.3	39.1
<b>Total value added</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

**Source:** Calculated from National Accounts of Thailand. (Chain volume measures: reference year = 2002)

**Figure 1** Share of the gross domestic product originating from transport, storage and communications in Thailand, 1990 – 2012 (%)



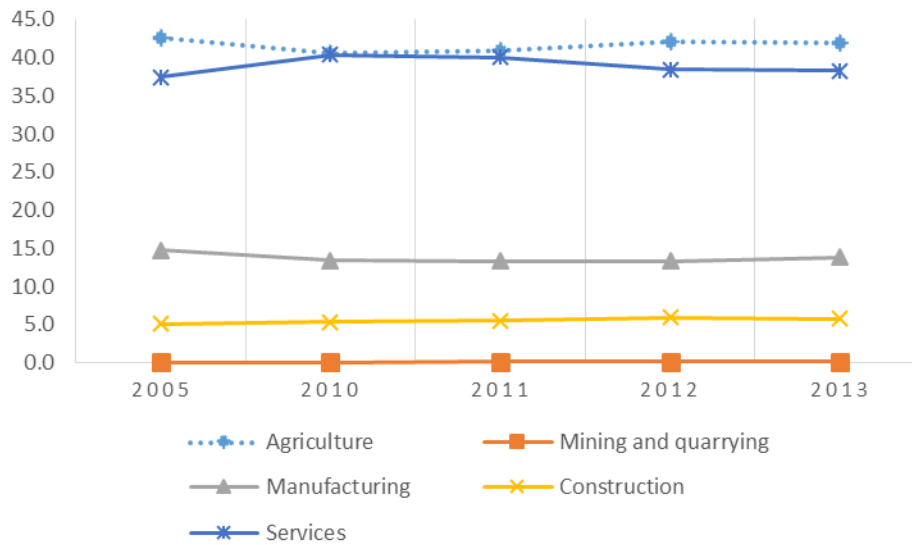
In 2013, the employment in agriculture and services sectors are accounted for 41.9 and 38.3 percent of total employment, respectively, while employment in manufacturing sector has been accounted for only 13.8 percent (see Table 3). Considering transport subsector, its output share in GDP has been increasing while the employment share of this subsector has decreased from 3 percent in 2005 to 2.3 percent in 2013. This might indicate that workers in transport subsector is more productive.

**Table 3** Share of Employment by sectors in Thailand, 2005 - 2013 (%)

Sectors	2005	2010	2011	2012	2013
Agriculture	42.6	40.7	41.0	42.1	41.9
Mining and quarrying	0.1	0.1	0.1	0.2	0.2
Manufacturing	14.7	13.4	13.3	13.4	13.8
Construction	5.1	5.4	5.5	5.9	5.8
Services	37.5	40.4	40.1	38.5	38.3
<b>Transport, storage and communications</b>	<b>3.0</b>	<b>2.7</b>	<b>2.3</b>	<b>2.4</b>	<b>2.3</b>
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

**Source:** Calculated from labor force survey, National Statistical Office of Thailand.

**Figure 2** Share of Employment by sectors in Thailand, 2005 - 2013 (%)



Labor productivity reflects the ability of an industry or country to generate higher income. Labor productivity is generally used to measure how efficiently labor hours are converted into output. An increase in labor productivity in any industry indicates that workers in that industry is becoming more efficient. Due to the large share of the transportation sector to the overall economy, this sector is considered as an important service sector to facilitate the overall economic growth. It is therefore useful to investigate labor productivity in transportation sector.

## 2. Objective

This paper attempts to determine the labor productivity of the transportation sector using the input-output analysis approach. The study incorporates four modes of transport which are rail transport, road freight transport, water transport and air transport. To determine productivity of labor in transport sector, this study utilizes “labor coefficients” calculated from input-output tables of Thailand for the years 1990, 1995, 2000 and 2005.

## 3. Methodology and Data sources

A major source of growth in an economy is the rate of growth in its economic productivity. The productivity of an economy are therefore widely used as indicators by which

to maintain economic growth. Productivity is defined as a measure of physical output produced from a given quantity of inputs. It exhibits how efficient a firm can use a set of inputs to produce an output. There are various measures of productivity, such as profitability indices, total output productivity, capital productivity and labor productivity. A number of measures of productivity can be expressed in input-output terms. Labor productivity is one of those measures which will normally be used to measure competitiveness in production process. Labor productivity of industry  $i$  ( $LP_i$ ) can be defined as:

$$LP_i = \frac{\text{total value of output in industry } i}{\text{total labor input used in industry } i}$$

Alternative measure of labor productivity is “labor coefficient” calculated from input-output table. The input-output table shows the relationship between the flows of goods and services between producers and the consumers in the economy. It indicates the interactions among industries. It also describes production process which explain the use of goods and services including value added generated within each industry.

Input-output analysis incorporate the interactions among industries using as a tool for economic impact analysis and to determine employment effects of technological change. Input-output analysis requires the estimation of input-output coefficients, which describe the amount of inputs needed to produce the outputs of each industry.

This study examines productivity of labor in transport sector by utilizing “labor coefficients” calculated from input-output tables. The labor coefficient of industry  $i$  ( $LC_i$ ) can be defined as:

$$LC_i = \frac{\text{labor expenses of industry } i}{\text{total costs of industry } i}$$

The labor coefficient of industry  $i$  ( $LC_i$ ) indicates the labor costs share in total cost of industry  $i$ . Since zero profit condition is assumed in the input-output framework, thus total costs of industry  $i$  and value of output of industry  $i$  are equal. Therefore,

$$LC_i = \frac{\text{labor expenses of industry } i}{\text{total value of output of industry } i}$$



In other word,  $LC_i$  explains the costs of labor required to produce 1 Baht of output in that particular year. To examine labor productivity using “labor coefficients”, this study will calculate an inverse of labor coefficients ( $1/LC_i$ ). The larger value of  $1/LC_i$  implies the higher labor productivity of that particular industry.

To calculated labor productivity and labor coefficients, this study uses data from labor force survey, national account of Thailand and the input-output tables of Thailand for the years 1990, 1995, 2000, and 2005 constructed by the Office of National Economic and Social Development Board of Thailand.

#### 4. Results

Using the formula in the previous sections, labor productivity ( $LP_i$ ) of major economic sectors can be calculated from  $LP_i = \frac{GDP \text{ at current market prices in industry } i}{total \text{ employment in industry } i}$  and the results are shown in Table 4 and Figure 3. This study found that labor productivity or output produced by one unit of labor in transport sector has increased from 0.527 in 2005 to 0.844 in 2011. For agriculture and services sectors, labor productivity in these sectors have not changed much while labor productivity in manufacturing sector has an increasing trend during the same period. It is interesting that labor productivity in transport subsector are higher than those in manufacturing sector. Moreover, labor productivity in transport subsector has shown a significant improvement, especially in 2010 and 2011 after a declining in 2008 and 2009.

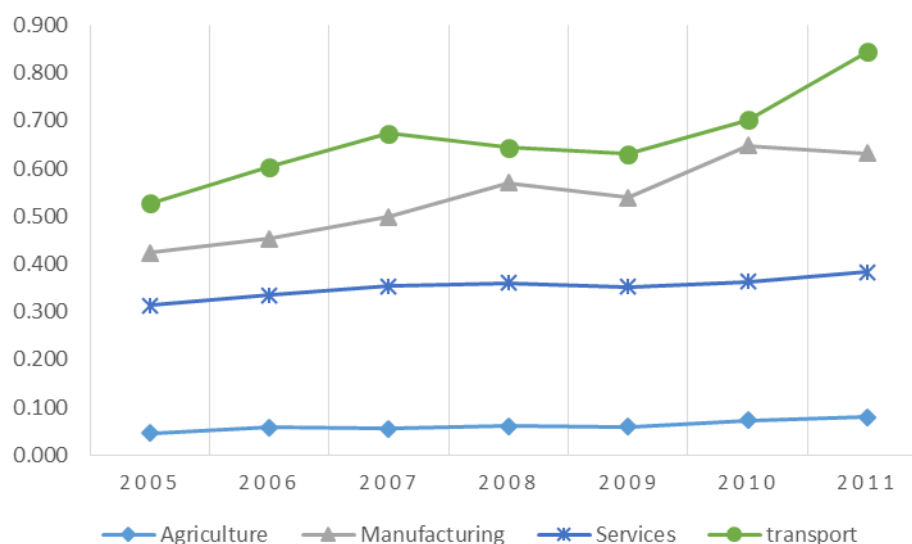
**Table 4** Labor productivity by sectors in Thailand, 2005 - 2011 (million Baht/person)

Sector	2005	2006	2007	2008	2009	2010	2011
Agriculture	0.045	0.058	0.055	0.061	0.059	0.072	0.080
Manufacturing	0.424	0.454	0.499	0.570	0.540	0.647	0.632
Services	0.314	0.334	0.353	0.360	0.353	0.363	0.383
<b>Transport</b>	<b>0.527</b>	<b>0.604</b>	<b>0.673</b>	<b>0.644</b>	<b>0.630</b>	<b>0.701</b>	<b>0.844</b>

**Source:** Calculated from:

- 1 National Account of Thailand, the Office of National Economic and Social Development Board.
- 2 Labor force survey, National Statistical Office of Thailand.

**Figure 3** Labor productivity by sectors in Thailand, 2005 - 2011  
(million Baht/person)



**Table 5** Labor coefficients of transport sector by mode of transport in 1990, 1995, 2000 and 2005.

Mode of transport	1990	1995	2000	2005
Road freight transport and land transport supporting services	0.102	0.095	0.102	0.109
Railways	0.583	0.688	0.787	0.891
Ocean, Coastal & inland water transport and water transport services	0.195	0.19	0.174	0.157
Air transport	0.148	0.161	0.152	0.164
<b>Overall transport</b>	<b>0.155</b>	<b>0.155</b>	<b>0.149</b>	<b>0.148</b>

**Source:** Calculated from Input-Output Table of Thailand, the Office of National Economic and Social Development Board.

To determine the labor productivity in each mode of transport, the labor coefficients are calculated from input-output tables of Thailand. Table 5 show that labor coefficients of road freight and land transport, air transport and overall transport have not changed much during the period of study. However, labor coefficients of ocean, coastal and inland water

transport have decreased slightly from 0.195 in 1990 to 0.157 in 2005. On the contrary, labor coefficients of railways have increased significantly from 0.583 in 1990 to 0.891 in 2005.

The results of labor coefficients above indicate that labor productivity of road freight and land transport, air transport and overall transport have not changed. However, labor productivity of ocean, coastal and inland water transport has improved while labor productivity of railways has become lower since 1990.

**Table 6** Inverse of Labor coefficients of transport sector by mode of transport in 1990, 1995, 2000 and 2005.

Mode of transport	1990	1995	2000	2005
Road freight transport and land transport supporting services	9.804	10.526	9.804	9.174
Railways	1.715	1.453	1.271	1.122
Ocean, Coastal & inland water transport and water transport services	5.128	5.263	5.747	6.369
Air transport	6.757	6.211	6.579	6.098
<b>Overall transport</b>	<b>6.435</b>	<b>6.472</b>	<b>6.707</b>	<b>6.754</b>

**Source:** Calculated from Input-Output Table of Thailand, the Office of National Economic and Social Development Board.

**Figure 4** Inverse of Labor coefficients of transport sector by mode of transport in 1990, 1995, 2000 and 2005.

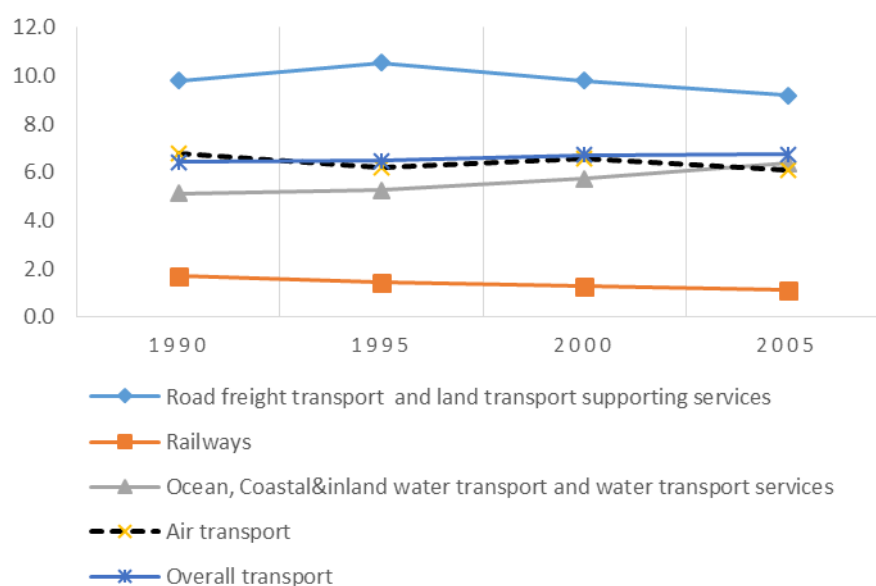


Table 6 and Figure 4 show the value of inverse of labor coefficients of transport sector separated by mode of transport in 1990, 1995, 2000 and 2005. The results show that road and land transport has the highest value of inverse of labor coefficient. This implies that labors in road freight and land transport are the most productive compared to labors in other modes of transport. However, as mentioned earlier, the larger value of inverse of labor coefficients implies the higher labor productivity of that particular industry. Although labors in road freight and land transport are the most productive, the results show that labor productivity of road freight and land transport has decreased significantly from 1995 to 2005.

Labor productivity of railways has also indicated a substantial decrease from 1990 to 2005, while labor productivity of air transport and overall transport have not changed much during the period of study. On the contrary, labor productivity of ocean, coastal and inland water transport sector has improved since 1990.

## **5. Conclusions**

This paper attempts to determine the labor productivity of the transportation sector using the input-output analysis approach. The study incorporates four modes of transport which are rail transport, road freight transport, water transport and air transport. The methodological setting is the utilization of the “labor coefficients” calculated from input-output tables of Thailand for the years 1990, 1995, 2000 and 2005. The results show that labor productivity of overall transportation sector have not changed much during the period of study. However, labor productivity of water transport sector has improved while labor productivity of rail transport sector has become lower since 1990.

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